COMPUTER SYSTEMS PLANNING REPORT

March 1967 - March 1968

OFFICE OF COMPUTER SERVICES

DIRECTORATE OF SCIENCE AND TECHNOLOGY

CENTRAL INTELLIGENCE AGENCY

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CONTENTS

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1. SCOPE

This report provides a short-term plan for revising and extending the computer systems in OCS. The plan considers only general-purpose computer equipment; it does not include a discussion of related peripheral devices in the Computer Center.

This report should be viewed as an addendum to the "OCS Computer Systems Planning Report," dated 1 June 1965; it provides an updating of that plan for the next twelve months. It is needed now because significant changes have occurred in user requirements and in the assumptions concerning equipment performance and OCS capabilities.

As we gained experience in the use of IBM 360 systems and became aware of deficiencies in performance and delays in software delivery, we made several changes to the original plan. But, until today, the changes in the plan were concerned with interim means for providing a bridge between second-generation and third-generation

equipment--the IBM 360/67 remained the ultimate goal. This paper represents a major departure from the original plan because of recent announcements from IBM reflecting their inability to design and implement an effective software package for the 360/67 system within the time frame of concern to us.

Even before this announcement, however, we knew that we had to contend with an increased computational load with sub-optimal 360 software performance; we also recognized the gaps in our understanding of precisely how the 360/67 would accommodate the wide spectrum of computing problems the Office must handle.

Briefly, we have concluded that what were interim measures before must now be considered as semi-permanent. Before we were focused on the 360/67 as the third-generation equipment goal, with the assumption that this goal was clear and the nature and sequence of the interim steps (smaller computers and interim software) was well-defined. Our view now is that, having made the first few steps, we find that the interim systems are not performing as anticipated, and the 360/67 (with its time-sharing system) is not a panacea, but that our investment in 360 systems is beginning to bear fruit. We want this investment to continue at low risk, however, by making the most of systems that work and remaining skeptical of the unproven. This shift in direction and pace need not be more expensive, will permit continued

full-scale service, but must be viewed as a slow evolution of our overall capabilities.

2. GENERAL PROBLEMS

Many of the developments since the writing of the June 1965 planning report reflect major problems whose solutions require modifications to the basic plan. The more important of these are discussed below.

2.1 IBM 360 Hardware Experience

Major delays have been encountered in the delivery and acceptance of 360 equipment. Our 360/65 was the eleventh such system delivered by IBM and has required over 300 man/hours of on-site engineering changes. Although delivered on 18 July 1966, it did not pass the acceptance test until 9 October 1966. IBM customer engineers lacked experience with this system, hence OCS operations suffered. Nagging hardware failures have been a constant problem. When the problems are identified and corrected, however, these systems meet the hardware performance levels on which planning was based. Such is now the case with our 360/65.

2.2 IBM 360 Software Performance

The IBM design plan for 360 software is ambitious and complex. The documentation is lengthy (it covers about five linear feet

already), but poor. The Operating System* for the IBM 360 has been in use only one year, but already has gone through nine major revisions (this could be contrasted with the Operating System for the IBM 7090, which is now in its fourteenth version since its release about four years ago). The software concepts are valid, but their early implementation has produced inefficiencies and considerable error. The flexibility of the software is a mixed blessing. The applications programmer must make choices in areas where none were available (or needed) before. This places a heavy burden on the programmer in specifying his job and responding to diagnostics provided by the system. Consequently, we have encountered a major learning problem and program test time has risen considerably.

2.3 Conversion Experience

The logistical problems involved in equipment changeover have occupied a considerable portion of OCS Staff time. The modularity of the 360 hardware, while an asset to configuration

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* An Operating System is a set of control and service programs which perform such functions as loading application programs in memory, allocating facilities needed by the application, translating FORTRAN and COBOL statements into machine instructions, maintaining program libraries, etc.

planning, has provided us with a seemingly infinite number of component combinations whose relative merits are difficult to analyze. Conversion programming is now progressing at a satisfactory rate, but, of necessity, has been given low priority compared with meeting basic user needs. This task has been reasonably straightforward for COBOL or FORTRAN programs.

2.4 User Needs

Projections of computer time needed by users have been consistently underestimated by OCS and its users. In general, our customers are becoming more sophisticated in ADP, have explored new applications as confidence in OCS increased, want to modify and expand jobs which have been in a production status, and are anxious to exploit the facilities of third-generation equipment. Further discussion of user needs is not given here because of the current effort by the O/PPB Information Processing Staff to generate an Agency Five-Year ADP Plan. We assume that we are aware of most of the requirements projected over the next few years. However, Parkinson's Law has applied to date. This near-term equipment plan represents a means of solving our immediate and critical needs.

2.5 Organization and Policy

In the past eighteen months, several changes in Agency policy and OCS organization have occurred; the former is

25X1A reflected in the publication of [redacted] which provides mechanisms for coordinating ADP activities and establishes a philosophy of partially centralized ADP. In addition, a significant increase in OCS resources has been approved. Finally, our early experience with the 360 systems has engendered a more cautious attitude on the part of OCS management and its users with respect to the schedule within which the full promise of third-generation systems can be realized.

3. OBJECTIVES

The basic objectives outlined in the June 1965 report remain valid: the aim toward a homogeneous set of hardware and software, equipment with large growth capability, provision for remote consoles, efficient software from the operator and programmer points-of-view, and around-the-clock computing capability. To this group of objectives might be added a need to provide a stable hardware environment from the programmer/user point-of-view. The need to reconfigure our systems several times in recent months because of significant new requirements and manufacturers' failures has been most unsettling.

4. CURRENT EQUIPMENT STATUS

The current OCS equipment picture is as follows:

4.1 IBM 360/65

The 360/65 system includes a 7090 emulator*, one-half million byte (byte = 8 bits) core memory, twelve magnetic tape drives, four disc storage drives, card reader/punch, and high speed line printer. With its high speed and flexibility, this system has considerable computing potential, but its potential has not been fully realized yet because of software inefficiencies, notably in control program compilers and the lack of a flexible multi-programming** capability. The multi-programming delay is the most significant. However, from a cost point-of-view, this system can be justified if only because of its replacement potential for the 7090. In the emulator mode, it operates somewhat faster than the 7090 at lower cost.

4.2 IBM 360/50

We now have two of these systems. The first one, acquired as a replacement for the 360/30, provides our basic input/output facility (tape-to-print and card-to-tape conversion), and was planned as the prototype time-sharing system. It has a

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* An emulator is a combination of hardware and software facilities that permits efficient simulation of one computer on another.

** Multi-programming permits concurrent operation of two or more independent tasks on one computer.

1/8 million byte core memory, five tape drives, two disc storage drives, a card reader/punch, and two high speed line printers. It has been operating effectively for one year as an input/output processor with a program designed by the OCS Technical Staff which executes three independent tasks concurrently.

The second 360/50 was acquired in December and passed its acceptance test in March. Its facilities include an IBM 1410/7010 emulator, quarter-million byte core memory, ten magnetic tape drives, four disc storage drives, card reader/punch, and high speed line printer. As with the 360/65, this system can be justified on a cost basis alone; emulator performance is equivalent to IBM 7010 performance at lower cost.

4.3 RCA 501 and 301

These systems continue to perform satisfactorily and absorb a very heavy computing load--a load which has required backup of about 60 hours per month at the CEIR Service Bureau in Washington. The 501 has 48,000 character (character = 6 bits) core memory, and the 301 has 10,000 character core memory. Other facilities include nine magnetic tape drives, card reader/punch, paper tape reader, and high speed line printer.

4.4 IBM 7010

Our IBM 7010 system includes 80,000 character (character = 6 bits) core memory, eleven magnetic tape drives, card reader/

punch, and high speed line printer. The load on this system has been heavy in the past, but is dropping quickly because several applications are now being converted to the 360 systems, and the 360/50 emulator will assume the remaining unconverted 7010 programs.

5. IMMEDIATE PROBLEMS

5.1 Computing Load

The June 1965 report estimated that the OCS computer load would quadruple over the next five years. Our experience in the past 18 months indicates that this estimate was low. An indication of the upward trend is given in the charts in Tab A, showing for each computer system the hours logged each month in CY-1966. All current systems are being used at least 500 hours per month. Additional statistics in Tab B give a comparison of the operational loads for the months of January 1966 and January 1967. For example, the printing load for IBM systems increased 44 percent, there was an increase in number of jobs processed on IBM systems of 130 percent, the OSA/OSP computer load increased by 72 percent, and RCA systems processed 21 percent more work. An indication of the current upward trend is the table below which shows the number of jobs processed by the Computer Center on IBM systems and the total hours logged and metered for all systems for the past

five months (where a "job" is an individual run submitted to the Computer Center). Note that the number of jobs has increased by 50 percent since September 1966. Metered and logged time* stayed nearly constant, at or near the maximum available in the month.

	Sept	Oct	Nov	Dec	Jan
No. of Jobs	2027	2462	2543	2674	3246
Logged Hours	1775	1709	1853	1621	1709
Metered Hours	1345	1257	1204	1129	1286

With respect to the RCA 501/301, as noted above, the load has exceeded the capacity of the Agency systems and has required significant outside support which is cumbersome from a security and procedural standpoint and is more costly.

The reasons for the increasing load on all OCS systems are many:

- The conversion load is reaching a peak, which will not slack off for at least another year.

- Existing applications, particularly on the RCA 501, have expanded, requiring increased test time and larger volumes of output.

- A large number of staff programmers are now writing programs for the 360 and have encountered learning

* Metered time is the time (read from meters installed on the equipment) during which the computer is performing work. Logged time is metered time plus job set-up time.

difficulties which require extensive program test time and many reruns. (This is a major reason for the increase in the number of jobs noted in the table above.)

- Difficulties in diagnosing basic source of System/360 errors (hardware, software, applications program) due to the lack of adequate diagnostic facilities--which must be quite elaborate because of the many layers of control interposed between the programmer and ultimate machine executions in the 360 system.

- Several new scientific applications requiring many runs, each measured in hours.

5.2 Heterogeneous Systems

We continue to be plagued with the need to handle a variety of operating systems, programming languages, and application peculiarities which demand special attention. When taken together, these variations and resultant special procedures constitute a major scheduling problem in the Computer Center. The Center, by virtue of its mission, must accommodate the needs of a wide spectrum of applications. Commonality of procedures remains an unattained goal which can be met only through patient attention to programming standards and gradual changeover to a new, homogeneous software system.

5.3 Hardware Configuration

The June 1965 report mentions the basic problem of the incompatibility of the RCA and IBM equipment in the Center. This problem remains, but is being attacked through (a) piece-meal

conversion of selected 501 programs, (b) the planned acquisition of an RCA Spectra 70 computer which will be partially compatible with the IBM 360 and will emulate 501/301 programs, and (c) ultimately, complete replacement of 501 programs with the DD/S SIPS System now under development.

A secondary incompatibility problem has developed within the IBM 360 systems themselves: each of the three systems we have acquired have different memory sizes and peripheral devices. Because of these differences, very few 360 jobs will run on more than one computer. We have been unable to dedicate a single system to normal 360 activity (note that two of these systems must be dedicated partially to emulation and the third entirely dedicated to input/output tasks). Thus, we now have a heterogeneous 360 facility which generates significant scheduling problems and provides little backup in the event of machine failure. Finally, one system--the first 360/50--was acquired in anticipation of the need for experimentation with time-sharing applications; it includes a variety of control units and terminal devices which have yet to be exploited because of the necessity to sacrifice the pace of development of this system for increased

attention to immediate Operating System/360 problems.*

6. SPECIFIC, IMMEDIATE OBJECTIVES

The near-term (FY-67 and 68) equipment plan outlined below should provide the means for meeting the following objectives:

a. A standard, stable, and powerful 360 configuration provided to programmers (see para. 7.b. below).

b. At least two systems having the standard configuration, which will provide backup and scheduling flexibility for the 360 (see para. 8.b. below).

c. Partial relief of the 501 computing load problem through the acquisition of an RCA Spectra 70/45 with 501 and 301 emulators (see para. 7.c. below and Tab C).

d. A minimal stand-alone 360 system dedicated to prototype time-sharing applications which will be manageable and represent a low risk to overall production needs (see para. 7.d. below).

e. Ability to continue processing 7090, 7010, 501, and 301 programs for as long as necessary until all conversion is complete.

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* Full exploitation of Operating System/360 is basic to our production capability and requires full-time attention of several OCS system programmers. It might be noted that the complexity and scope of the software is such that several thousand programmers at IBM are engaged in its development.

f. A flexible card-to-tape, tape-to-print and paper tape processing facility which will minimize scheduling problems and provide sufficient backup for peak loads (see para. 7.e. below).

g. Partial realization of third-generation software concepts (automatic scheduling and device allocation, remote job entry) until a full, integrated package is available from IBM (see para. 10.4).

7. NEAR-TERM COMPUTER PLAN - SUMMARY

The elements of the near-term computer system plan are outlined below in rough chronological order:

a. The first 360/50 will be connected to the 360/65 in order to conduct a test of the Attached Support Processor (ASP) System. Assuming a successful test, this connection, along with an IBM software package which augments Operating System/360, should provide a powerful, integrated facility for serial job processing on the 360. Under this system, input operations and ultimate outputs would be provided by the support processor (Model 50) with computational work and data manipulation carried on by the main processor (Model 65). The support processor would also perform job scheduling and device allocation tasks and communicate with the system operators. It performs its scheduling function in a way which

permits mixing of 7090 emulation and 360 tasks without regard to the sequence of job submission. In a few months, IBM plans to augment ASP so that it will support facilities for remote job entry. Results from preliminary tests of the ASP System at other installations are encouraging, but can be misleading because performance of such a system is very sensitive to the mix of jobs processed. Although the ASP System is mentioned several times in this plan, its success is not crucial; sufficient (but less flexible) computer power can be obtained from the planned components in stand-alone configurations.

b. A second 360/65 will be acquired. If the ASP System performs satisfactorily, it will be connected (as a second main processor) to the Model 50(1). This will provide parallel processing paths with considerable job scheduling flexibility. The expanded ASP System will also provide for disconnecting the three processors (i.e., the two 360/65's and the 360/50) in the event of failure of any of them so that the remainder can operate independently. The second 360/65 will also have an IBM 7090 emulator.

c. An RCA Spectra 70/45 with 501 and 301 emulators will be acquired. The Operating System will permit concurrent operation of one 501 program, one 301 program, and one

Spectra 70 program. It will also provide for direct execution of programs written in 360 assembly language. Its emulation speeds should be such that the workload currently performed by the RCA systems in the Agency and at CEIR can be totally absorbed by this system. Even though a significant portion of our current RCA system has been purchased, the cost analysis (summarized in Tab C) indicates that our net costs will remain essentially constant with perhaps a slight cost advantage to the Spectra 70 System. While this acquisition runs counter to our goal of homogeneous systems, it is necessary and appropriate at this time. Full-scale conversion of RCA 501 programs is not worthwhile because new programs will be needed to support the DD/S Support Information Processing System now being designed. Partial conversion directly to the 360 is planned, but the RCA 501/301 load will continue to be heavy. The Spectra 70--with its 501 emulation speeds, reasonable cost, and partial compatibility with the IBM 360--will help to solve the immediate 501 problems.

d. A 360/40 will be acquired with minimal facilities to handle the already planned prototype time-sharing applications. These applications are: COINS, Commo Computational Facility, OCS Personnel Information System, Security Name Checking (SANCA), CHIVE Dictionary Query Experiment, and

Computer-Assisted Instruction.* This system will be acquired when the necessary communication lines are installed and the time-sharing control programs and application packages have been tested in the IPRD facility. The time-sharing control programs have been constructed by the OCS Technical Staff personnel and are in advanced testing stage. They have been designed in such a way as to permit expansion to more applications and will permit processing of normal Operating System/360 jobs that do not require man-machine dialogue facilities.

e. Two 360/20 systems will be acquired (separated by four months) to provide input/output backup for peak printing loads and conversion of independent EAM jobs. These low-cost systems will alleviate input/output scheduling bottlenecks which are occurring with increasing frequency. Although the ASP System will provide primary input/output capability, that system will operate at maximum efficiency if it is dedicated to processing jobs with standard print forms.

f. Both 360/50 systems will be upgraded in memory

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* These were selected by OCS because they represent a cross section of potential time-sharing applications. We want to investigate the problems associated with each application type, and (just as important) we want to see how the system will behave when processing this heterogeneous group of tasks simultaneously.

size and peripheral devices. The first 360/50 will require additional memory and peripheral devices to accommodate the needs of ASP. The second 360/50 will be upgraded to make it compatible in size and facilities with the 360/65. The latter will be done immediately to provide parallel processing paths for 360 activities.

g. The second-generation systems will be released in the following order: IBM 7010, RCA 501, and RCA 301. Release dates will depend on emulator performance, 360 processing load, and program and file conversion progress.

h. An undetermined major system (i.e., of the 360/65 size) will be added to the Computer Center to accommodate the anticipated growth in the computer load toward the end of the period covered by this plan. The basic need has been established, (principally to meet OSP requirements and anticipated interest in time-sharing), but selection of the system will sepend on a number of factors:

- Degree of success with the 360/40 time-sharing system and its suitability for expansion.
- The extent of customer demands for man/machine conversational capability.
- IBM's progress in redesigning the time-sharing system for the 360/67.
- The ability of the ASP System to accommodate remote job entry facilities and a crash priority scheme (with

facilities for resuming normal processing when the priority task is complete).

- Further experience with the growing load for scientific computation.

The acquisition of this major system will permit the release of the second 360/50 which has been scheduled for purchase and transfer to DD/P (third or fourth quarter of FY-68).

8. PLANNING DETAILS AND SCHEDULING

The specific components to be acquired and released under this plan are spelled out below and the schedule and relationship between events is summarized in the chart in Tab D.

a. In March 1967, make the Model 50(2) and Model 65(1) compatible. The standard system configured for the Computer Center customers will be an IBM 360 of 524,000 bytes of memory, eleven tape drives, and five 2311 disc drives which will be replaced by one 2314 direct access storage facility in mid-1967. Additional core and disc drives were previously ordered for the Model 50(2), bringing these up to the Model 65(1) configuration. In addition, a tape drive is to be transferred from the Model 65(1) to the Model 50(2), giving both eleven tape drives.

b. In March 1967, convert the Model 50(1) to an ASP for the Model 65(1). Since a second Model 65 is planned for connection into the ASP System (see below), a minimum of a Model 50 is required to maintain proper balance between the support and main

processors. An ASP test will be conducted by a temporary connection between the Model 50(1) and Model 65(1). The increase in throughput power and decrease in job turnaround time of the ASP over the stand-alone Model 65's will be measured and evaluated carefully. A performance increase of at least 15 percent on the Model 65's is anticipated.

c. In May 1967, install a Model 20(1). The Model 20(1) provides peripheral support such as tape-to-print and card-to-tape. The ASP provides primary support to the Model 65's, and the Model 20(1) will handle the peripheral support to the Model 50(2) and the ASP printing overflow. In addition, the Model 20 will provide EAM support and give additional capability to convert EAM jobs. Equally important, it will provide an easy and quick method of producing short listings for customers. The Model 20 peripheral support software is being written by IBM according to Computer Center specifications.

d. In May-June 1967, install a second Model 65. The acquisition of this system will partially offset the negative effects of IBM's notification of delays in Model 67 software support. (The first Model 67 had been scheduled for delivery in November 1967.) With the additional Model 65 which meets the Computer Center standard configuration, two major,

parallel processing paths (both with 7090 emulators) will be available. The advancement of the installation date is necessary to match load requirements which were to have been absorbed by multi-tasking software on the Model 50(2) and Model 65(1). Load requirements, as projected through FY-68 from computations derived from information available from our customers, cannot be met under single-tasking software without the early acquisition of a third major system.

e. In May 1967, release the IBM 7010. The assumption is made that all IBM 7010 programs will emulate on the Model 50(2), and preliminary tests indicate a high probability of success. The Model 65(2) will have been installed, thus absorbing enough load so as to free the Model 50(2) to handle all IBM 7010 work (through emulation). It will not be necessary that the Model 65(2) complete its acceptance test before IBM 7010 release.

f. In July 1967, install an RCA Spectra 70/45.

g. In July 1967, substitute a 2314 direct access storage device for the 2311 disc drives, on both the Model 50(2) and the Model 65(1).* Since the Model 65(2) is to be installed with

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* The 2314 is equivalent in storage capacity to approximately twenty-eight 2311's. The 2314 data transfer rate is twice that of the 2311. Its cost per bit is one-third that of the 2311.

a 2314, this substitution will bring the three systems to the Computer Center standard configuration planned for that time.

h. In August 1967, install a Model 20(2). Primarily, this addition is a backup to the Model 20(1) but a second Model 20 is necessary to handle the anticipated peak print loads and processing of converted EAM activities.

i. In August 1967, install a Model 40(1). This is planned as a stand-alone time-sharing machine. Acquisition of such a system is essential to the development of a full time-sharing capability for several of the larger Agency applications. The delay of Time-Sharing System software for the Model 67 has left a gap in Agency capability. This acquisition will allow a compartmentation of select jobs into one system which will be particularly important during the test phases of security compartmentation. The acquisition date coincides with the schedule for CIA's connection into the COINS System.

j. In January 1968, release the RCA 501/301. The RCA 70/45 will have both the RCA 501 and 301 emulators.

k. In February 1968, install another major system. The decision on this system will be affected by the factors discussed in para. 7.h. above. This system will replace the 50(2) in

March-April 1968. For purposes of estimating costs, this system is assumed to be a 360/65 (or equivalent).

9. COSTS

The costs for the early months of the plan are well within the FY-67 budget (see Tab E). For FY-68 the total lease figure of $2,315,705 (see Tab F) exceeds the previously established budgetary limit by $79,000; however, the purchase items total $3,572,544 (see Tab G), or $627,456 less than the FY-68 purchase allotment of $4,200,000. The surplus in the purchase budget and the deficit in the lease budget trade-off so that OCS will be able to balance its budget upon the selection of the additional equipment to be purchased rather than leased.

Even though the FY-68 plan as presented shows no significant change in total budget from the FY-68 plan as approved, there are some significant budget changes on specific items. No one item is really outstanding, but rather several specific items contribute to the mutual tradeoffs in the total picture. Several items emerge:

a. The Model 40(1) is a new system not in any previous plan and shows as $365,000 in the FY-68 budget. However, of this total approximately $130,000 is for items such as extra core and direct access storage pertinent to COINS and SANCA. This cost must be included as part of other systems if the Model 40 were not to be ordered.

b. Approximately $72,000, extra core and transmission control, is budgeted for the ASP as a result of the FMSAC requirement for a remote job entry terminal.

c. Approximately $240,000 can be attributed to the advancement of the date for the Model 65(2) which was originally to have been the Model 67(1) in November 1967. This advancement is a reaction and compensation for delays in IBM multi-tasking software.

d. Purchase of the main frame (CPU, core, channels) of the Model 65(1) on July 1967 is recommended. This computer will be of value to OCS for at least four years, well past the breakeven point on purchase versus lease.

e. Purchase of both main frames of the Model 50's is recommended for 1 July 1967. Although OCS has no long-term plans for these, DD/P does and it is to the advantage of the Agency to purchase. Also, peripheral components consisting of a printer, card reader/punch, and control unit are recommended for purchase on the same date.

f. Purchase of both Model 20's and all peripherals is recommended, the first on 1 July 1967 and the second when it is installed. The Model 20's will be useful for many years, very probably in OCS.

10. ALTERNATIVES, CONTINGENCIES, AND IMPLICATIONS

10.1 Alternatives

Three fundamental alternatives to this plan are discussed here (abandon the 360, abandon the single system objective, and freeze planning pending a complete analysis) as well as several possible adjustments within the plan (substitution of smaller models of the 360 and deletion of the 360/40 or the 360/20's).

10.1.1 Alternatives to this Plan

a. Re-direct Planning Away from IBM 360 Systems - Many of the problems discussed in this report constitute an indictment of IBM for failure to deliver high quality equipment and software, so it is appropriate to raise the possibility of abandoning the IBM 360 route. Two alternatives exist: (1) retrogression to second-generation equipment such as the IBM 7000 series or (2) substituting another major manufacturer's third-generation system. The first alternative does not seem reasonable because emulation of programs written for second-generation equipment has proved to be economically and operationally sound. Secondly, like it or not, we have already begun to see wholesale abandonment of second-generation

equipment and software systems by users (who might otherwise help us) and by manufacturers. With respect to the second option, there would be little advantage in replacing the problems associated with one manufacturer's equipment with those of another. We believe that the problems IBM and its users have encountered are not atypical; the industry as a whole is in a volatile state. It is generally agreed, however, that third-generation hardware and software capabilities are an improvement even though they are not completely implemented nor performing yet as anticipated. The most significant factor here, however, is the sizeable investment already made in IBM 360 training, conversion, and application planning, which we believe is beginning to pay off--even though at a rate slower than planned or desired. In brief, we believe that it is wise to move into some third-generation system; the choice of IBM appears to be no better or worse than other manufacturers.

b. Abandon the Philosophy of a Homogeneous Computer System - The development of a homogeneous system remains an OCS goal. However, the difficulties in realizing a fully integrated third-generation capability on a single system suggest that it might be feasible to

reconsider this objective, replacing it with one that aims toward several smaller systems, each optimized for one application area--e.g., one for scientific computation, one for information retrieval, etc. The argument here would be that each system could be selected for its ability to meet a smaller set of requirements, would introduce less overhead, and would facilitate less generalized and more efficient software. Indeed, if OCS did not exist as a centralized facility, Agency computing would probably be moving now in the direction suggested here. More specifically, however, we see that on balance the multi-purpose system objective remains valid. Some arguments that support this are: the CIA/OCS job mix is very dynamic, so it would be difficult to configure, for example, a system for "scientific" work with any greater confidence than we could under a single system concept; backup machines would have to be provided for each kind of the smaller, specialized systems; a centralized facility, once established, can be more efficiently managed under the single system concept; the availability of higher level programming languages makes the question of single and multiple systems irrelevant to the programmer, who is

interested more in programming ease and flexibility than he is with machine efficiency.

c. Freeze Planning Pending Complete System Analysis - This plan is vulnerable to questions such as: Is the planned configuration the "best"; what specific bottlenecks exist in computer operations; is remote access really required; would it be possible to shorten program test time with improved procedures in lieu of more equipment; what additional capability is really being added here; and in what situation would we find ourselves if this equipment were not ordered? All these questions are legitimate, but cannot be answered in a completely satisfactory way. To do so, would require a complete operations research study, including large-scale simulation, cost effectiveness studies, etc. One might argue that a moritorium should be called on any large-scale planning until such an analysis is completed. It is paradoxical that, although the computer has been useful in operations research, it has not been successfully applied in the analysis of computer centers--here or elsewhere. We collect data and derive statistics on our computer load, but this analysis is only a partial help in selection of specific components or in piecing them

together. We are just beginning to study simulation as a possible tool for computer system analysis, but we know that such analysis techniques will have limitations. Particularly troublesome is our difficulty in anticipating needs of customers so that we can respond in a timely fashion. We see no advantage to an exhaustive analysis at the moment; we would prefer to acquire and test systems and techniques, and to take limited steps in equipment acquisition in order to stay one step ahead of our customer requirements.

10.1.2 Alternatives within this Plan

a. Delete Requirement for 360/40 - Two possibilities exist here: continue to use the IPRD facility indefinitely, or handle time-sharing activities within 360 systems already available in the Computer Center. The first possibility is not feasible because most of the time-sharing applications are being designed for components in Headquarters Building, and we wish to encourage a pseudo-operational environment, guaranteeing availability of the system during normal working hours. The second alternative was rejected because we wish to separate the developmental aspects of time-sharing (including security, engineering, and programming elements) from our normal

production stream.

b. Substitute Smaller Models of the IBM/360 Systems for the Second 360/65 - This possibility was rejected for a number of reasons: (1) duplexing the 360/65 will give us considerably more power than duplexing the smaller models, (2) the cost of peripheral devices--which is now a major portion of computer system expense--would be about the same for smaller systems, and (3) the cost differential between the 360/65 and the smaller models is insignificant compared with the difference in computer power (scientific tasks run about six times faster on the Model 65 than they do on the Model 50).

c. Delete 360/20's from the Plan - Although these systems cannot be justified as readily as other elements of the plan, we feel that the flexibility that 360/20's will provide in reducing bottlenecks in printer scheduling is well worth the relatively small cost.

10.2 Contingencies

This plan is based on several assumptions relating to adequate performance of software and vendor's ability to meet our schedules. We think the assumptions are reasonable and, for the most part, no one assumption is crucial to our ability to meet our commitments. Several contingencies are listed

below which would require some modification to specific elements of the plan:

a. Inferior ASP Performance - It is possible that the ASP System may not prove to be worth its cost. Some quantitative evaluation of ASP will be made, but intangible factors such as materials handling, procedural errors committed, etc. will be just as important. If our overall judgment indicates that the ASP System is the wrong way to go, we will discontinue the first 360/50 and replace it with some other input/output capability, e.g., additional 360/20's or a 360/30 with multiple printers and card readers.

b. Unacceptable Performance of RCA Spectra 70 - As indicated in our letter of intent to RCA, installation of the Spectra 70/45 is contingent upon its being able to: (1) Perform the workload of the presently installed RCA 501 and RCA 301 Systems and CEIR Service Center operations within a seven-day week, three-shift operation; (2) process the Agency's RCA 501 and RCA 301 programs as they are written without additional programming; (3) compile and run assembly language IBM 360 programs; (4) compile and run Spectra 70 and IBM 360 COBOL programs without change; (5) process and generate IBM 360 tapes (data, tape,

and reel compatible); and (6) produce printed output of the same character spacing and character set as the existing RCA 301 Model 333 printer. The first two of these requirements are the most critical. Failure to meet any of the others will have less influence on our decision to accept this system. In the event of non-acceptance, it would be necessary to continue and perhaps expand our use of RCA 501 facilities at CEIR, to expend effort in making existing 501 programs more efficient, to accelerate the pace of converting 501 programs to the 360, or to seek other methods for relieving the 501 computer load.

c. Unusual Demands for Time-Sharing Capabilities - Our prospects for limited success on the 360/40 time-sharing system are good. It is possible that we will be besieged by requests for applying this new capability to users' problems. In spite of our efforts to proceed at a reasonable pace, demonstrations of time-sharing capability will be required and will tend to be over-bought, even if they are under-sold. If sufficient pressure is brought to bear for this capability without reductions in our normal data processing load, additional hardware may be needed--possibly replacing

the 360/40 with a much larger machine. The principal counter-balancing factors here will be the time required to install communication lines and terminals and saturation of our analytic and programming resources.

d. Security Problems - The success of several elements of this plan depend on adequate means of assuring good security. The effects of inadequate security facilities must be considered from the user's and computer operation's point of view. These two viewpoints roughly correspond with two planned systems--Time-Sharing and ASP, respectively. If the probability of compromise appears high in instances where separate applications co-reside in the 360/40, the time-sharing concept may have to be temporarily abandoned or severely modified to keep separate applications on separate machines (the latter is tantamount to abandonment of time-sharing as well because few applications would economically support a stand-alone time-sharing system). An equivalent risk exists in the ASP System; the support processor must be capable of secure processing of co-resident applications. Failure here would mean abandonment of the ASP System; in this case the discussion mentioned in sub-paragraph a. above applies.

10.3 Effects on On-Going or Planned Applications

As mentioned previously, OCS participation in COINS will be handled through the 360/40 to be acquired in August 1967. The Office of Communications already is making plans for installing the initial set of remote terminals and communications lines in Headquarters Building (which will handle the other proto-type time-sharing applications as well). Prior to installation of the 360/40 in the Computer Center, OCS will rely heavily on the equivalent system in ORD/IPRD for COINS checkout.

The need for additional computer support to OSP, which was surfaced in the past six months, has had a significant impact on our systems planning. This requirement includes the need for tight production scheduling with guaranteed computer availability, the need to handle high priority tasks (hopefully without disrupting on-going production), and inclusion of facilities for data communications between the Computer Center and other sites. It is not a real-time application, but it is the closest thing to it that OCS has encountered. The 360/67 and its associated software, if available and performing properly, would have adequately handled this requirement. Lacking the 360/67, two possibilities are open to us: expansion of the ASP System or expansion of the OCS-constructed time-sharing system to include

the facilities needed by OSP on a larger computer. The plan is sufficiently open-ended to handle this requirement under either of the two options with a decision required by the summer of 1967.

FMSAC has expressed the need for a communications link between a computer in the OCS Computer Center and a medium-sized computer in FMSAC which will handle the front-end processing of teletype material. This configuration and its associated programs are part of a FMSAC experiment in automatic dissemination of intelligence text. This will be our first attempt to provide remote job entry and will be handled through the ASP System. FMSAC is also one of the first candidates for inclusion in an expanded time-sharing system. Their intent is to provide analysts with direct access to space event files.

The two major information system projects in the Office--CHIVE and SIPS--should not be adversely affected by this plan. The question of how well such large application systems will operate under a time-sharing or traditional batch processing environment (particularly when jobs processed under these systems are made part of the normal Computer Center flow) were not answered before this plan was generated and must remain unanswered for quite some time, regardless of immediate plans.

The ANDI (analog-to-digital) System can be accommodated under this plan. The potentially high rates of data transfer

between ANDI and the 360/65 and the unknown load that this system represents will present scheduling problems, but the availability of a second 360/65 will provide flexibility that was not planned previously.

It is intended that the Security Automated Name Check Activity (SANCA) be included in the early test of the time-sharing system on the 360/40. Delays in IBM support to the data cell storage device (the anticipated storage medium for the SANCA file) may cuase delays in this test.

Our other applications can be accommodated by this plan. It was mentioned previously that the improved stability of the planned hardware systems should have a positive effect on applications planning.

10.4 Effects on Long-Range Computer Systems Planning

The wide spectrum of capabilities desired in third-generation computer systems need not be abandoned; indeed, several of these can be exploited under this plan as they become available. The most significant ones are discussed below:

a. Data Management - This capability includes functions of cataloging data files, protection for these files, device independence, and various modes of file organization and access. Basically, these are services which theoretically should ease the burden of program design. The data

management facilities under Operating System/360 are maturing slowly. We intend to continue using this operating system for the indefinite future and will exploit these facilities as they become usable and efficient.

b. Operations and Job Control - Under the assumption that the computer itself can play a role in managing job flow and resource allocation, software facilities have been developed and used for the past several years which include facilities for automatic job scheduling, machine utilization accounting, retrieving programs from a library, etc. These functions are intended to be implemented on the third-generation software with more sophistication, efficiency, and flexibility. The implementation of Operating System/360 in this regard has produced mixed performance: some facilities are very good and others are very, very bad. The software under the ASP System, while taking cognizance of the Operating System/360, has proceeded at a faster pace. It includes advances in these facilities (among others) which we believe will permit us to at least partially realize some of the promised efficiency in the operational management of new computer systems.

c. Multi-Programming (or Multi-Tasking) - This facility--which permits concurrent operation of two or more independent tasks on one computer--is another attempt to get more efficient use from available facilities. It is not meant as a programmer aid. This capability has been achieved under limited conditions. Attempts to expand it to a more general operating environment have encountered severe difficulties. While it has been recognized that an overhead price must be paid for this facility (larger memories and more peripheral devices), it is now questionable whether the efficiencies gained will compensate for the overhead costs which are estimated to be quite high (at least for IBM systems). If and when a true multi-programming capability becomes available (as contrasted with limited applications such as concurrent input/output operations) we should be able to take advantage of it under Operating System/360. At this point, however, we remain skeptical.

d. Remote Job Entry - This facility permits a programmer to present his job directly to the computer and receive his outputs with little or no intervention by Computer Center production control personnel. It is equivalent to moving several input devices (card readers,

magnetic tapes) and output devices (magnetic tapes, card punches and printers) to locations convenient to the programmer. The computer itself continues to operate in the traditional way--one job at a time.* The ASP System will support remote job entry within the next six months and we intend to experiment with it when it becomes available. When coupled with appropriate priority scheduling schemes, this facility should satisfy customer requirements for fast response when on-line dialogue capability is not required. IBM intends to expand Operating System/360 to include remote job entry, but it will be several months before delivery and will require extended tests.

e. Man/Machine Conversation - This facility is the essence of the time-sharing concept. It permits interleaving of many tasks on a single computer by using a timing mechanism. It differs from multi-programming, where control is passed from one task to another on the basis of the availability of a given processing unit. Time-sharing, on the other hand, assures the availability of processor to each user while his task is active. (Putting

* This facility should not be confused with the type of man/machine communications implicit in the time-sharing concept--see below.

it another way, in multi-programming, control is passed from one task to another at the convenience of the computer; in time-sharing, control is passed at the convenience of the user.) Because each user is given "slices" of time and because other tasks are not delayed when the user stops processing to analyze results, the user can intervene in the process he has prescribed without reducing the efficiency of the computer. A limited time-sharing, conversational capability has been developed by the OCS Technical Staff personnel for operation on the planned 360/40. It has many of the characteristics which are to be included in the large time-sharing system under development by IBM. It should be noted, however, that the system is little more than a framework within which the programmer must provide the specific processing prescription and means for interaction for a particular application. This in-house activity has shown sufficient promise to warrant considering its expansion to cover more functions and to include facilities for background, sequential, batch production. Inclusion of the latter facility is vital if such a system is to be justified economically (see "Integration" below).

f. Teleprocessing - A teleprocessing facility

permits a computer to absorb digital data from communication lines. This is similar to remote job entry facilities, but with one important difference: it must accept data in a piecemeal fashion and is aubject to asynchronous data transmission rates imposed by the data source. That is, the computer must be ready to accept data (but not necessarily process it fully) at any time. This facility is required for OSP (and possibly for other applications

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such as [redacted] and should be available through the Operating System/360 when needed.

g. Multi-Processing - This term identifies the concept of coupling two or more central processors electronically such that each will share equally the processing burden imposed on the system as a whole. (Note that the ASP System does not qualify under this definition in that, though coupled electronically, the processors perform different functions.) Multi-processing is advantageous in time-sharing applications because, like multi-programming, it provides better balancing of facility utilization. It is not vital, however. Multi-processing also permits realization of the "fail soft" concept where processing can continue at a sub-optimal level in the

event of component failure. This plan does not include any provision for multi-processing; however, the OCS Time-Sharing System could be expanded to include multi-processing, or the system developed for the 360/67 (when completed) could provide this capability for us.

h. Integration of Third-Generation Concepts - There is a general consensus in the data processing industry that the ultimate third-generation goal is the integration of all of the above facilities in one system. It is only through such a homogeneous package that large, central systems can economically accommodate a wide variety of jobs. For example, we would like the computer to schedule itself for orbital calculations, payroll, and FORTRAN compilation while analysts are working at consoles and data is being received from communication lines, with operator activity at the computer limited to mounting files and keeping printers supplied with paper. This goal is realizable, but has not been attained by any manufacturer. It might be noted here that other large installations have, like us, pieced together elements of third-generation capabilities. This raises the question of whether we could move faster at lower cost by using systems developed elsewhere. We

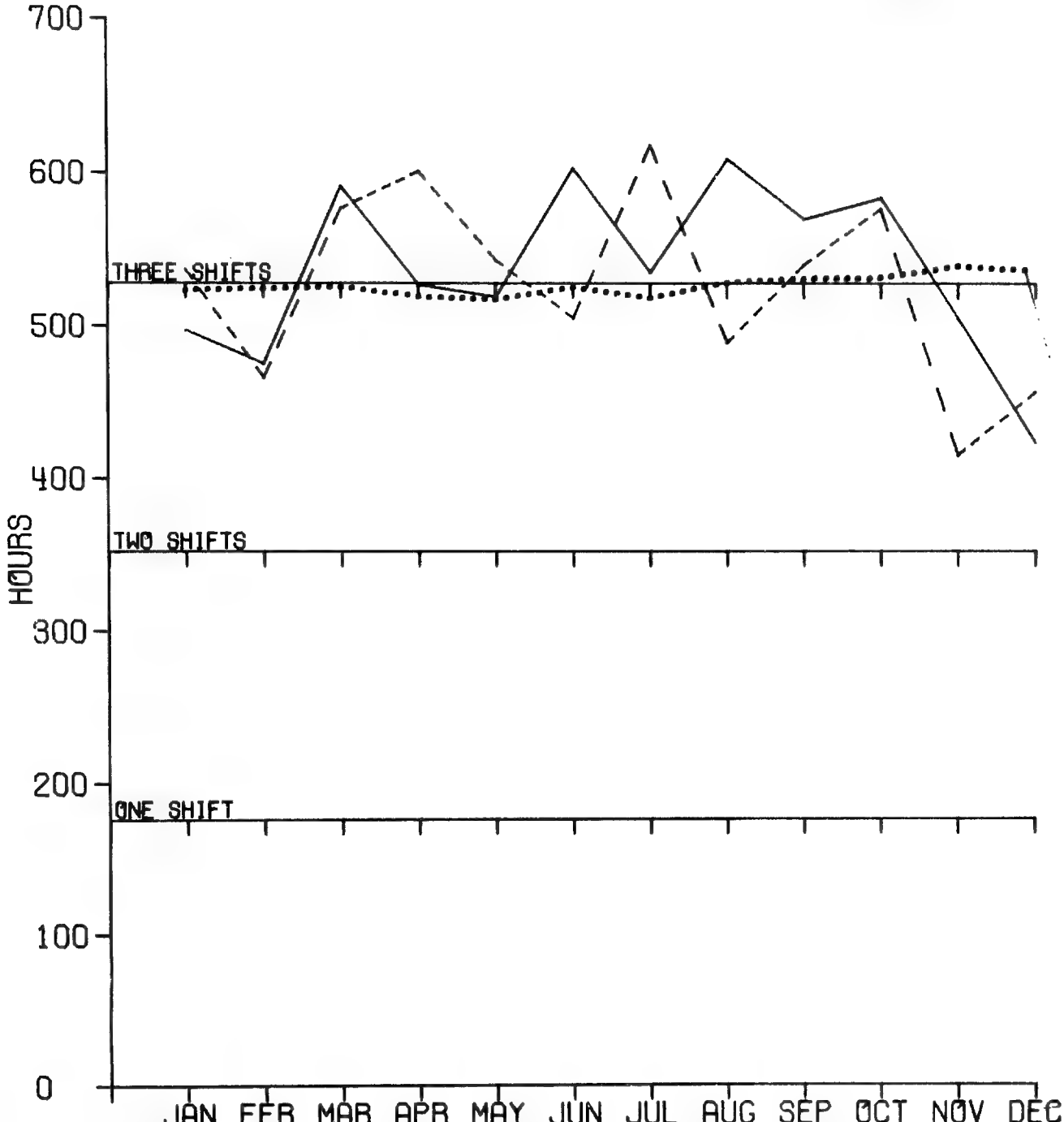
have looked into several of these and have found that they are tailored to requirements that are different from ours in one way or another. A three-pronged approach seems to be the best: (1) use vendor-supplied software systems as a base, (2) tailor the system to our needs through in-house efforts, and (3) add any elements (not systems) developed elsewhere that fit the vendor base as modified by our people. Our equipment plan retains enough flexibility to pursue this philosophy.

TAB A

01 JANUARY 1967

COMPUTER UTILIZATION- IBM 7010

PRODUCTION, SET-UP, TEST, RERUN, MAINTENANCE



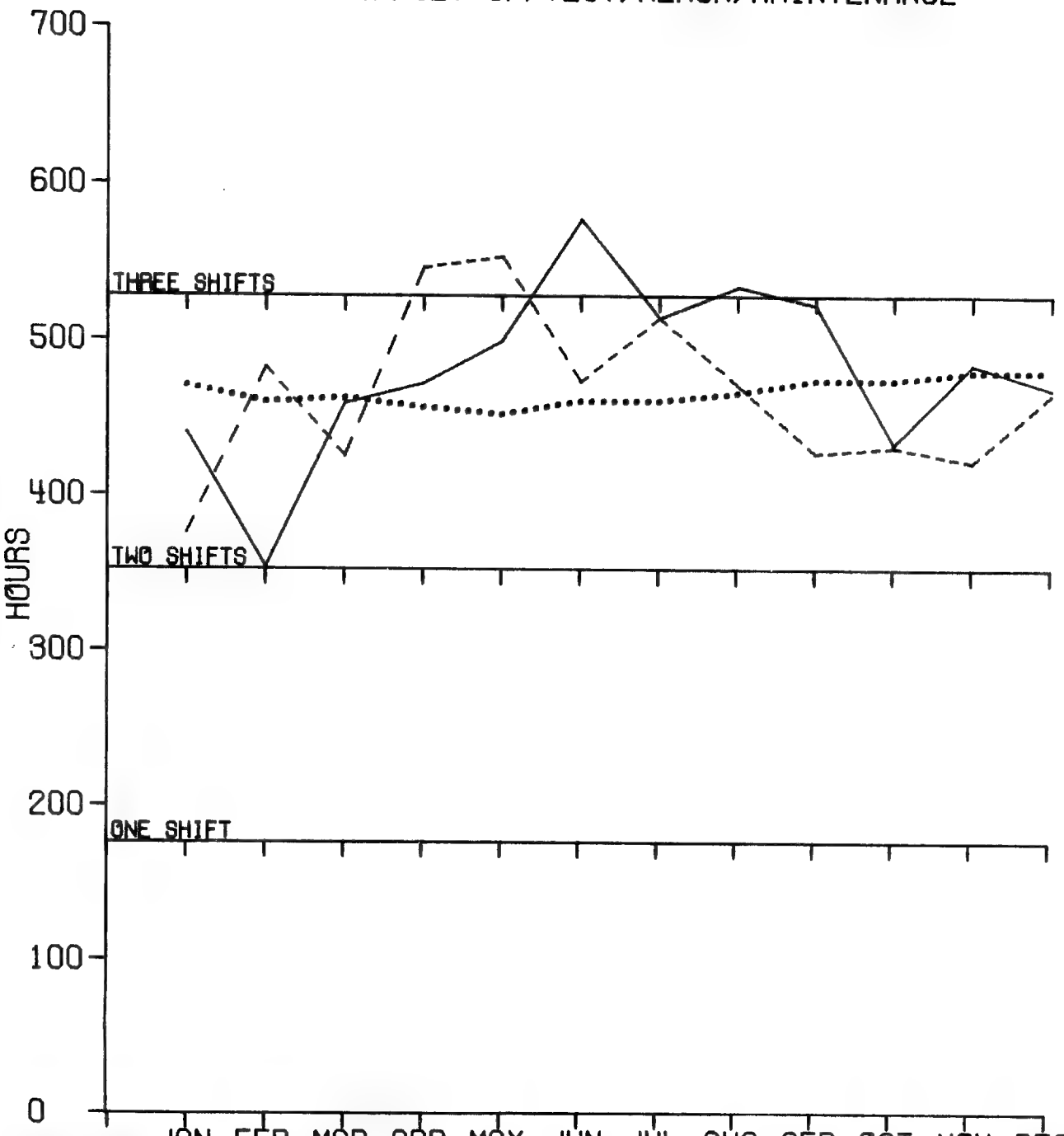
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(1965)	LAST YEAR	537	466	577	601	543	505	618	489	540	577	415	457
(1966)	THIS YEAR	497	475	591	527	519	609	535	609	570	584	505	429
	12MO AVG	523	524	525	519	517	525	518	528	531	531	539	536

UTILIZATION PRIOR TO JULY 1965 IS FOR IBM 1410 SYSTEM WHICH WAS REPLACED WITH IBM 7010 SYSTEM .

01 JANUARY 1967

COMPUTER UTILIZATION- IBM 7090

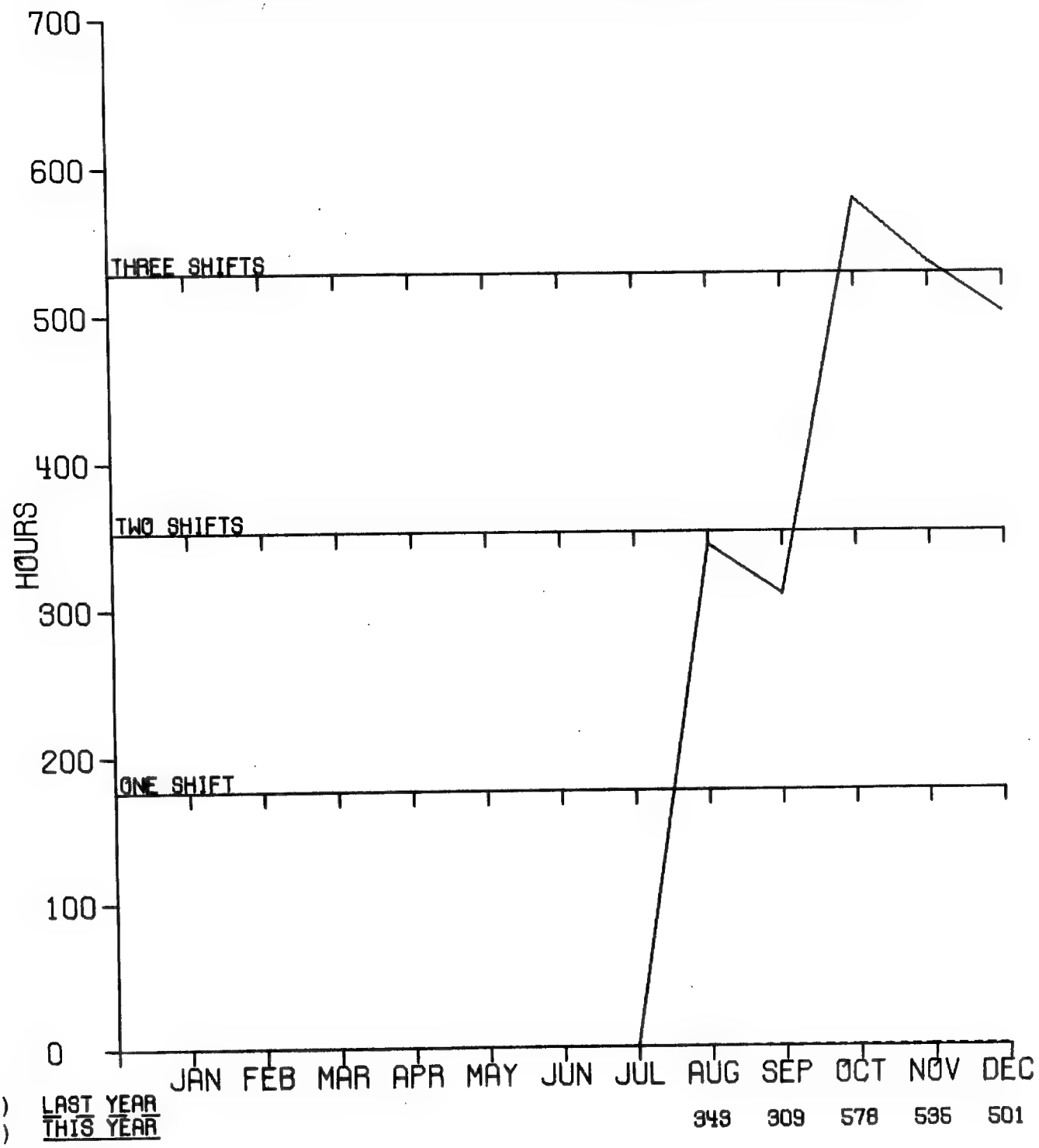
PRODUCTION, SET-UP, TEST, RERUN, MAINTENANCE



		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(1965)	LAST YEAR	375	482	425	546	569	479	514	471	427	491	421	465
(1966)	THIS YEAR	440	969	459	472	499	677	514	594	522	433	484	468
	12MO AVG	470	459	462	456	452	460	460	466	473	474	479	479

COMPUTER UTILIZATION- IBM 360/65

PRODUCTION, SET-UP, TEST, RERUN, MAINTENANCE



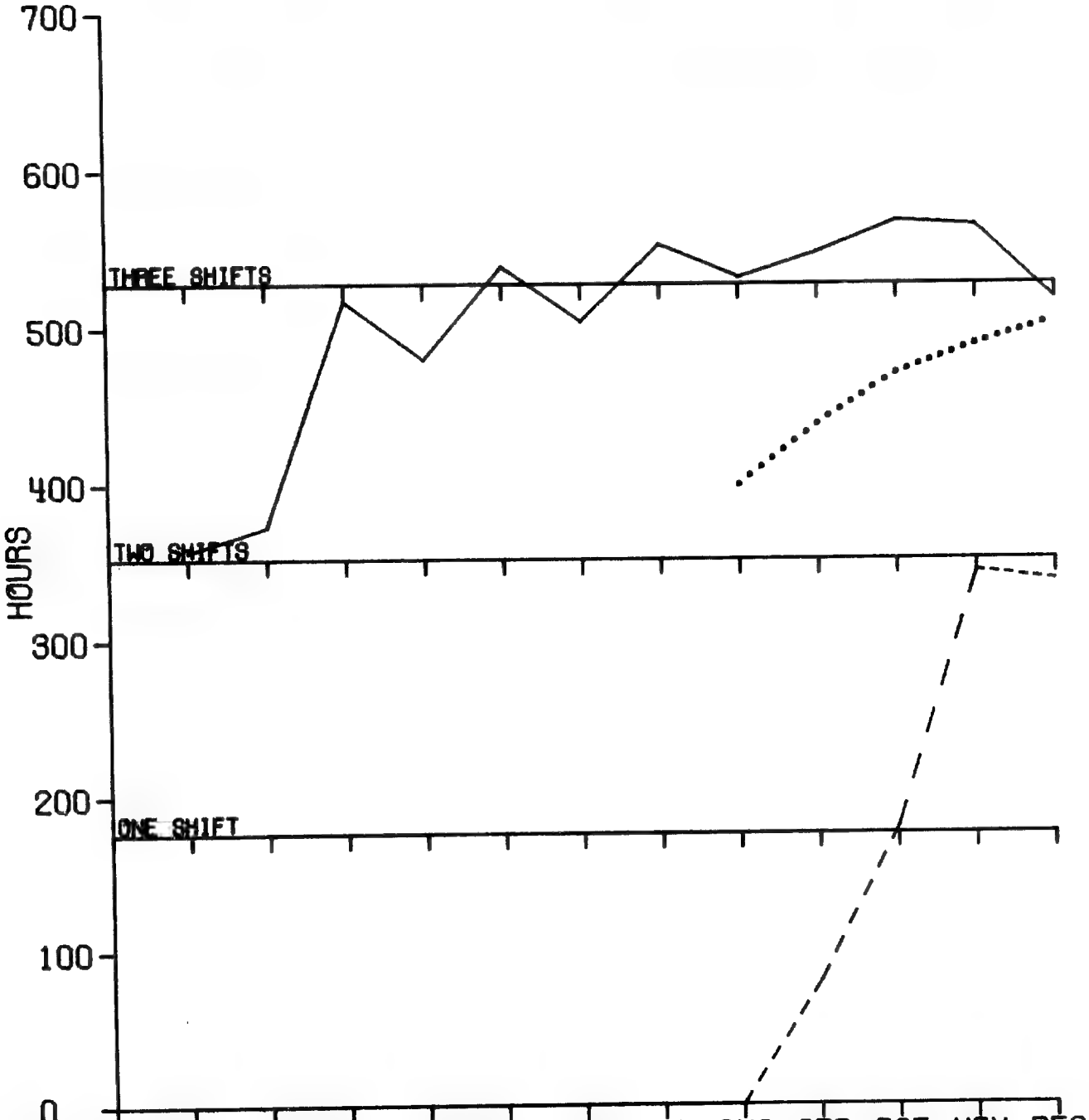
		AUG	SEP	OCT	NOV	DEC
(1965)	LAST YEAR					
(1966)	THIS YEAR	343	309	578	535	501

INSTALLED JULY 1966--- DEC. USAGE INCLUDES 19 HRS OF EMULATION
338 HRS OF OS AND 19 HRS OF BOS (SPOOL)

JANUARY 1967

COMPUTER UTILIZATION- IBM 360/50

PRODUCTION, SET-UP, TEST, RERUN, MAINTENANCE

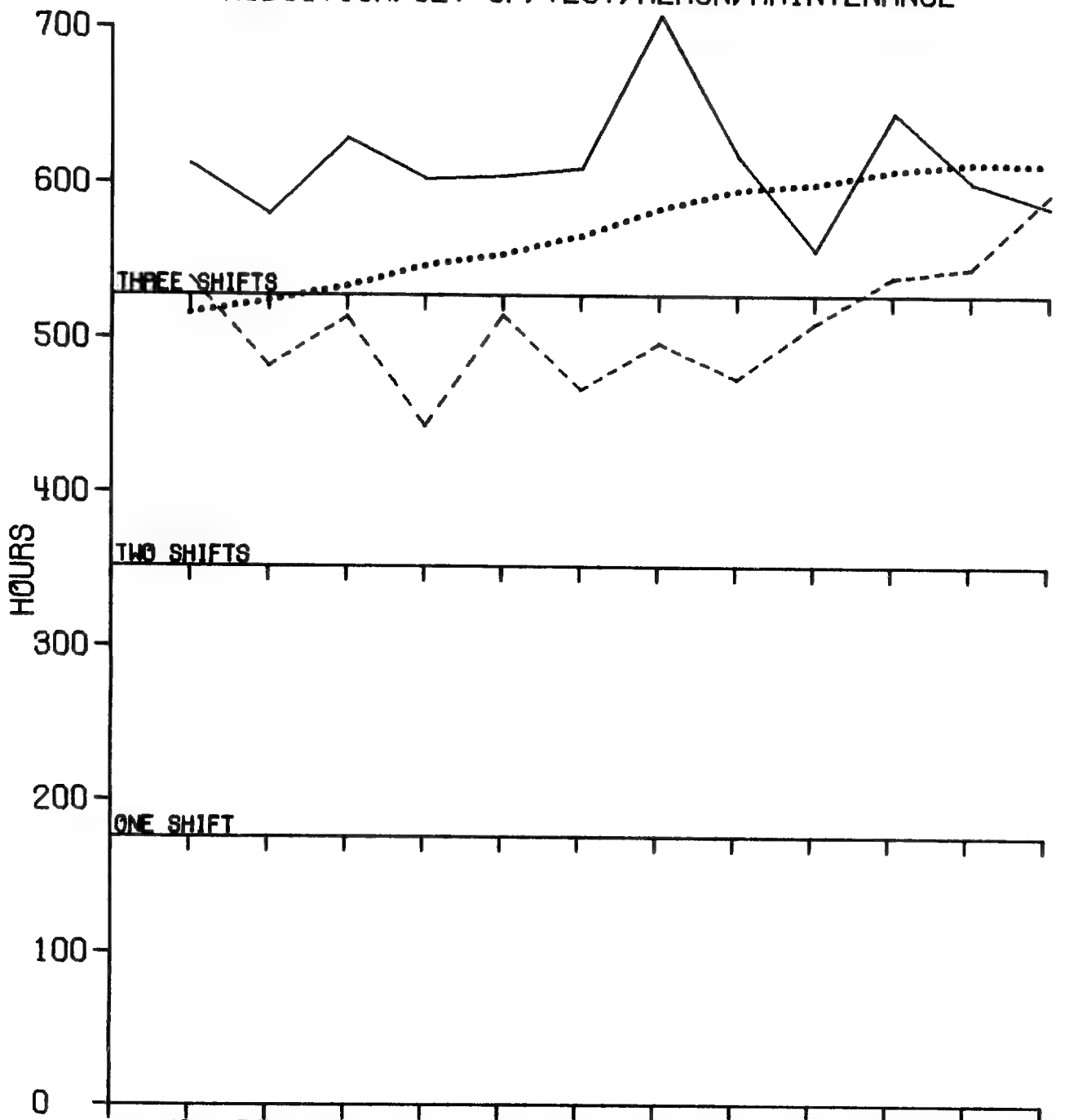


UTILIZATION PRIOR TO MAY IS FOR IBM 360/30 SYSTEM WHICH WAS REPLACED ON 10 MAY 1966

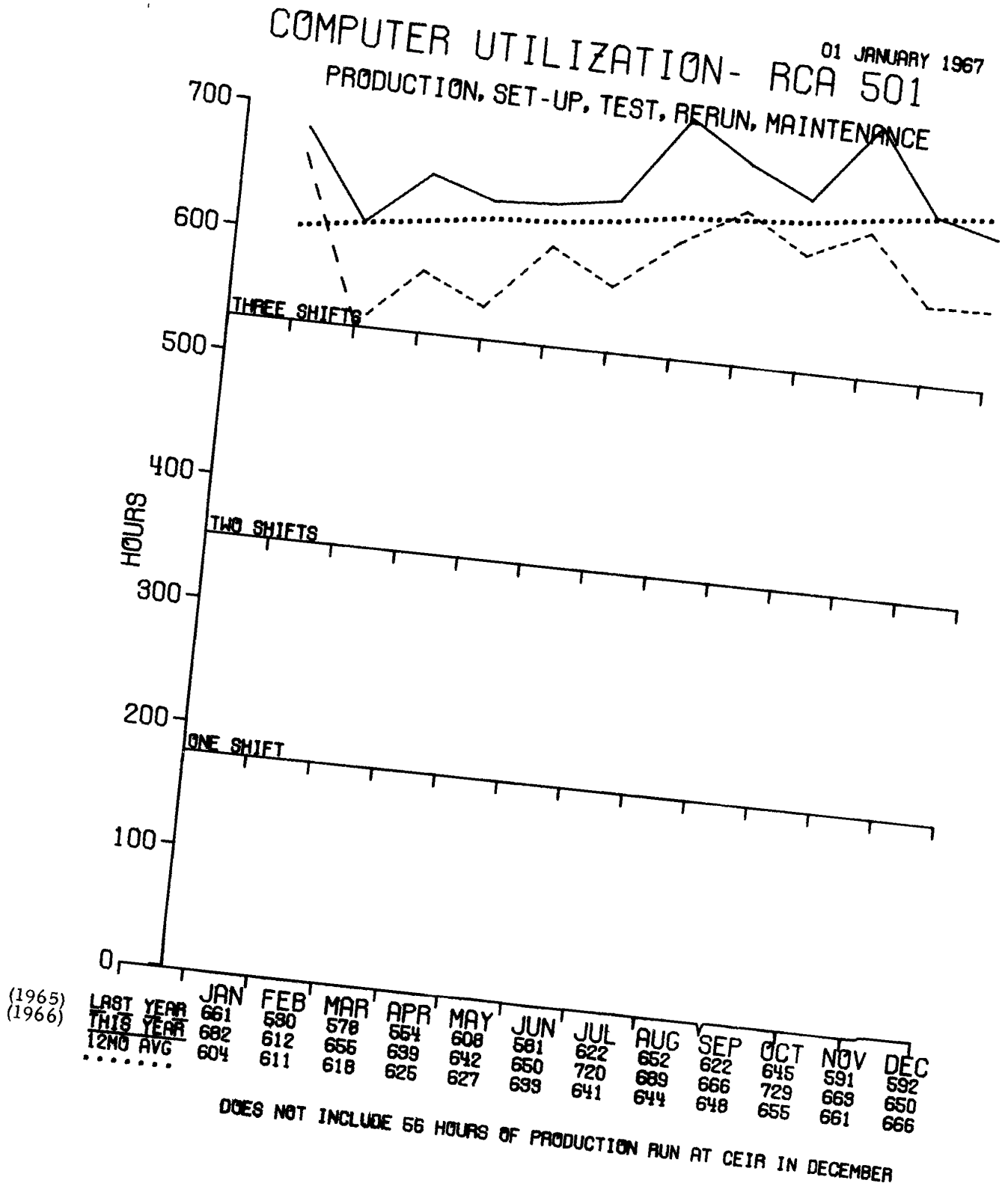
01 JANUARY 1967

COMPUTER UTILIZATION- RCA 301

PRODUCTION, SET-UP, TEST, RERUN, MAINTENANCE



		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(1965)	LAST YEAR	539	482	514	443	515	467	497	474	510	540	546	594
(1966)	THIS YEAR	612	580	629	609	605	610	708	618	557	646	601	585
	12MO AVG	516	524	539	547	554	566	584	596	600	609	613	612



TAB B

COMPUTER LOAD
January 1966 vs. January 1967

	1-31 Jan 1966	1-31 Jan 1967*	Increase	Percentage Increase
No. of Active Applications	136	184	48	35
Tape Inventory	6,669	7,818	1,149	17
Jobs Run (IBM Systems)	1,400	3,246	1,846	130
Lines Printed (360/50-1)	5,289,333	7,658,447	2,369,114	44
Cards Read (360/50-1)	509,650	1,225,600	715,950	146
Significant Customer Increase (Hours)				
OSA/OSP (7090)	90	155	65	72
OF (501)	270	351	81	30
(301)	295	338	43	15
OL (501)	79	102	23	29
(301)	40	93	53	133
Overall 501 Workload (Hours)	641	779	138	21
Program Test Time (Hours)	414	601	187	45
Total "Power-on" Hours**	3,194	3,587	393	12
Total Log Hours	2,405	3,023	618	26
Total Meter Hours	965	1,286	321	33
Total Overtime Man/Hours	1,685	1,576	109	- 6
Total Man/Hours (including overtime)	10,805	14,144	3,339	31

* Does not include OCS use of OCR and ORD/IPRD facilities in January 1967.

** Power-on time = logged time plus idle time; Logged time = metered time plus job set-up time.

TAB C

COST ANALYSIS AND JUSTIFICATION FOR RCA SPECTRA 70/45

1. The following is a summary of the expenditures that should be eliminated by the installation of the Spectra 70/45. Some are actual; some estimated. Based upon these figures, the installation of the Spectra 70/45 would indicate a reduction in monthly expenditures of $94, assuming, of course, that the Spectra equipment performs as stated by RCA. This is to be demonstrated by RCA prior to installation.

2. Monthly Rental of Spectra 70/45 $17,155

RCA 501 Maintenance	$2,018		
RCA 501 Extra Use Maint.	1,004		
RCA 501 Memory Rental	1,187		
Paper Tape Feature Rental	288		
Sub-Total		$4,497	
RCA 301 Rental		4,826	
Compatible Tape Station & Control (#3485)		1,446	
Monthly CEIR Costs (Est)		5,400	
Overtime Costs @ CEIR (Est)		1,080	17,249
Estimated Net Monthly Decrease in Overall Expenditure			$ 94

3. This trade-off in cost is further supported by the following advantages:

a. Having to operate one computer instead of two and, therefore, one less operator per shift.

b. Acquiring a paper tape read and punch capability at low cost.

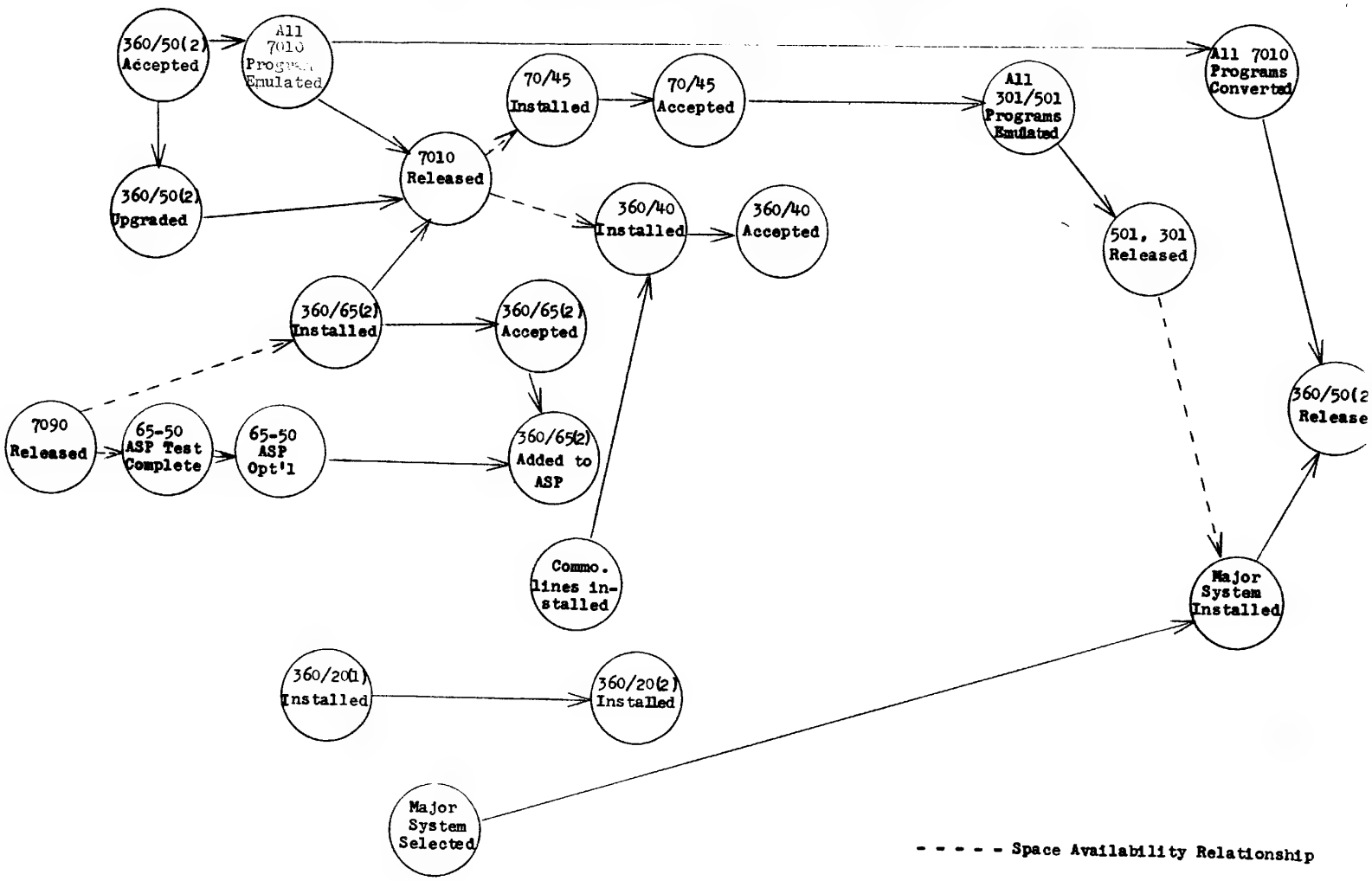
c. Being able to write new programs in either ALC or COBOL which are either compatible or nearly compatible with S/360 systems.

d. Being able to bring RCA operating procedures more in line with general Computer Center operating procedures.

e. A reduction in space requirements in the Computer Center.

4. The advantages, of course, are somewhat offset by the cost/effort to train personnel - both operators and programmers - in the effective use of new computer systems. However, this should be no greater a problem than having to go from second-generation IBM systems to third-generation IBM systems.

TAB D. EQUIPMENT PLANNING MILESTONES



FEB 1967 | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN 1968 | FEB | MAR

TAB E

FY-67 RENTALS *

SYSTEM	MONTHS	RATE	TOTAL
COINS Equip	4	5,000	$ 20,000
EAM	12	5,000	60,000
B/L Plotter	6	1,400	8,400
ANDI Mod 30	4	12,500	50,000
ALP	4	21,000	84,000
	3	2,500	7,500
CDC 915	8	3,450	27,600
	3	3,700	11,100
IBM 7010	2	37,000	74,000
	4	5,000	20,000
	2	-	-
	3	33,000	99,000
IBM 7090	2	60,000	120,000
	4	7,000	28,000
RCA 301	12	6,400	76,800
RCA 501	2	8,000	16,000
	10	1,500	15,000
IBM 360/50(2)	1	43,000	43,000
	3	43,700	131,100
IBM 360/50(1)	6	22,000	132,000
	3	23,000	69,000
	3	25,300	75,900
IBM 360/20(1)	3	4,800	14,400
IBM 360/65(2)	2	52,200	104,400

* None of the listed equipment is to be purchased in FY-67

SYSTEM	MONTHS	RATE	TOTAL
IBM 360/65(1)	1	10,000	$ 10,000
	1	25,000	25,000
	1	50,000	50,000
	3	60,000	180,000
	2	61,400	122,800
	3	62,000	186,000
		TOTAL	$1,861,000

25X1A [redacted]

TAB F

EQUIPMENT RENTALS AND PURCHASES
FY-68

System	Months	Monthly Lease Rate	Total Lease	Purchase
EAM	6	4,000	$ 24,000	$ -
EAM	6	3,000	18,000	-
ALP Mark Reader	12	2,500	30,000	-
CDC-8092	12	3,700	44,400	-
RCA-301	7	6,400	44,800	-
RCA-501	6	1,500	9,000	-
RCA-70/45(1)	11	17,155	188,705	-
IBM-360/20(1)	12	-	-	183,905
IBM-360/20(2)	10	-	-	183,905
IBM-360/40(1)	10	36,500	365,000	-
IBM-360/50(1)	2	4,600	9,200	-
	10	11,500	115,000	770,759
IBM-360/50(2)	8	21,000	168,000	1,034,740
IBM-360/65(1)	12	21,100	253,200	1,399,235
IBM-360/65(2)	12	61,200	734,400	-
IBM-360/65(3) (or equiv.)	4	78,000	312,000	-
			$2,315,705	$3,572,544

25X1A [redacted]

TAB G

SUMMARY OF PURCHASE ITEMS

Component	Description	Purchase Price (as of 1 Jul 67)	Rental
IBM 360/65(1) System:			
2065-I	Processing Unit	$ 513,085	$16,500
2860-3	Selector Channel	192,500	4,500
2365-2	Processor Storage	693,650	21,200
IBM 360/50(1) System:			
2050-H	Processing Unit	657,794	17,600
2821	Control Unit	45,840	1,300
2540	Card Reader/Punch	30,980	750
1403-N1	Printer	36,145	1,050
IBM 360/50(2) System:			
2050-I	Processing Unit	1,034,740	25,500
IBM 360/20 Systems:			
2020-C	Two complete systems consisting of:	367,810	9,200
	8K Central Processing Unit		
	4448 1403 Attachment		
	4658 I/O Channel		
	8099 2560 Attachment		
	8637 Universal Character Set Adapt.		
	1580 Card Print Control		
	1403-N1 Printer		
	8640 Universal Character Set Feature		
	1416-1 Interchangeable Train Cartridge		
	2415-1 Tape Unit		
	7125 Track Compatibility		
	2560-A1 EAM Processor		
	1575 Card Print (1st two lines)		
	35503 RPQ Column Binary Punch		
	Total	$3,572,544	$97,600